

# Integrated Component and System Analyses of Instabilities in Test Stands, Phase II

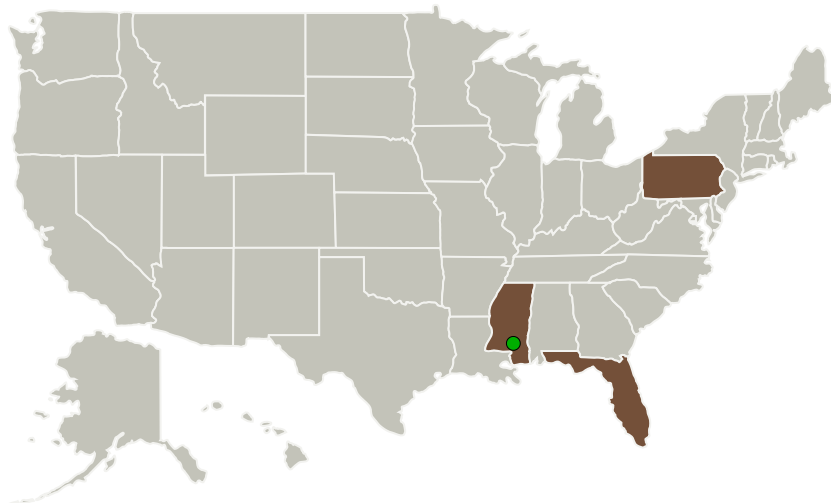
Completed Technology Project (2010 - 2013)



## Project Introduction

Instabilities associated with the operation of liquid rocket propulsion systems and test facilities usually manifest themselves as structural vibrations and may cause structural damage. While the source of the instability is directly related to the performance of a component such as a turbopump, the associated pressure fluctuations as they propagate through the system have the potential to amplify and resonate with natural modes of the system. In this proposal, a novel multi-level (system and component) instability analysis tool is proposed to identify these resonant modes. In Phase I of this program, a Transfer Matrix based approach was developed to analyze the propagation of an instability through a limited range of components such as ducts, bends, orifices and diffusers. The initiation of an instability was resolved with the help of high-fidelity CFD simulations. Demonstration of the tool was successfully carried out for the propagation of an instability in a scaled down system. In Phase II, the tool will be expanded to include a wider array of components such as turbopumps, valve systems etc. This will permit analysis of a greater range of instabilities from multi-phase instabilities involving cavitation based events in turbopumps to valve based instabilities such as water hammer.

## Primary U.S. Work Locations and Key Partners



Integrated Component and System Analyses of Instabilities in Test Stands, Phase II

## Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

## Integrated Component and System Analyses of Instabilities in Test Stands, Phase II

Completed Technology Project (2010 - 2013)



Organizations Performing Work	Role	Type	Location
CRAFT Tech - Combustion Research and Flow Technology	Lead Organization	Industry	Pipersville, Pennsylvania
● Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, Mississippi
University of Florida	Supporting Organization	Academia	Gainesville, Florida

Primary U.S. Work Locations	
Florida	Mississippi
Pennsylvania	

## Project Transitions

▶ **August 2010:** Project Start

✓ **February 2013:** Closed out

## Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/139115>)

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

CRAFT Tech - Combustion Research and Flow Technology

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Principal Investigator:**

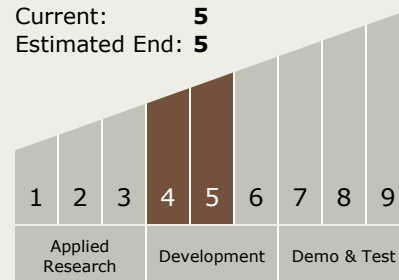
Vineet Ahuja

## Technology Maturity (TRL)

Start: 4

Current: 5

Estimated End: 5



# Integrated Component and System Analyses of Instabilities in Test Stands, Phase II

Completed Technology Project (2010 - 2013)



## Technology Areas

### Primary:

- TX01 Propulsion Systems
  - └ TX01.1 Chemical Space Propulsion
    - └ TX01.1.1 Integrated Systems and Ancillary Technologies

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System